



ABSOLUTE AND RELATIVE GRAVITY MEASUREMENTS IN QAQORTOQ (GREENLAND) IN AUGUST 2007

Final Report

October 2007

Prof. Dr. Olivier Francis

University of Luxembourg

Faculty of Sciences, Technology and Communication

Campus Kirchberg

6, rue Coudenhove-Kalergi

L-1359 Luxembourg

Grand-Duché de Luxembourg

Tel. : +352 46 66 44 6264, Email : olivier.francis@uni.lu

Foreword

This report contains the results of absolute and relative gravity measurements carried out in Qaqortoq (Greenland) in August 2007.

The absolute gravimeter FG5#216 from the European Center for Geodynamics and Seismology was operated by Olivier Francis and Gilbert Klein from the University of Luxembourg. The relative gravity measurements were carried out with the spring gravimeter Scintrex CG5 (S/N021210010) from the University of Luxembourg. This campaign was done in close cooperation with René Forsberg and Bo Madsen from the Danish National Space Center.

A new absolute gravity site has been established. The vertical gravity gradient was also measured at the absolute gravity site with the spring gravimeter. The gravity tie between the absolute gravity site and the 88204 marker of the national gravity net has been measured. The other marker 88111 could not be connected as it does not exist anymore due to the extension of the harbor. Instead, we established two new points: one on the first step of the old church and the other one on a big boulder close to the church.

The spring gravimeter Scintrex was left at the station for continuous measurements. One month of the data collected after the absolute gravity campaign has been analyzed to extract the observed tidal parameters. They have been used to correct the absolute gravity measurements for the Earth body tides and from the gravitational attraction and elastic loading due to the ocean tides.

We would like to thank Erik Rasmussen for his warm welcome in Qaqortoq. His invaluable help in all the aspects (logistic, medical,) has been highly appreciated. Bo Madsen kindly arranged a phone line for us.

This absolute gravity measurements campaign was funded by the University of Luxembourg and the European Center of Geodynamic and Seismology.

1. Absolute Gravity measurements

The absolute gravity observations were performed at the first floor of the Tele Greenland facility in a storage room. A sketch of the room is displayed in Figure 1.

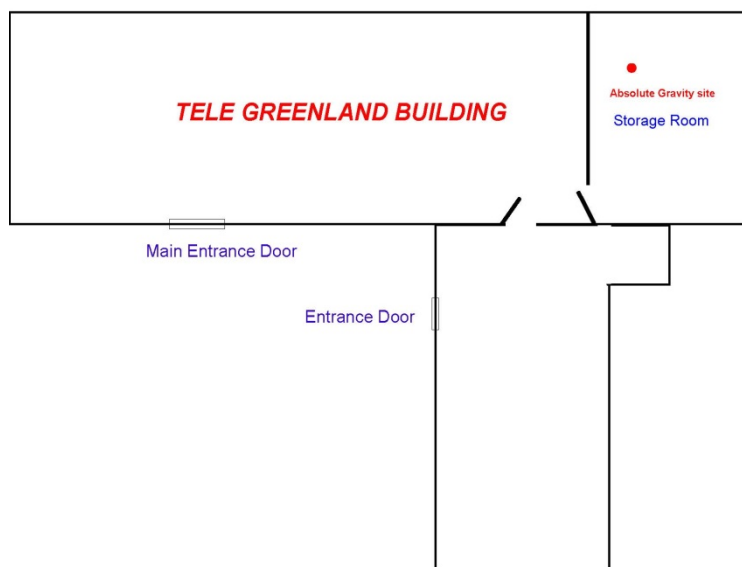


Figure 1. Sketch of the absolute gravity site in the Tele Greenland Building in Qaqortoq.

A picture of the set-up of the absolute gravimeter FG5#216 on the site is shown in Figure 2. The gravimeter was installed more or less in the middle of the room close to the door on the concrete floor. In the same figure, the Scintrex CG5 is visible on the right corner of the room.



Figure 2. The FG5#216 from the ECGS at the absolute gravity station of Qaqortoq located in a storage room at the first floor of the Tele Greenland Building.

1.1 Data processing

Raw data from the absolute gravimeters consist of vectors of time and position of the falling object during the drops. To obtain the gravity value, a linear equation representing the equation of motion is fit to the raw data including the gravity gradient which has been measured with relative meters.

The data processing follows the protocol adopted during absolute gravimeters comparisons at the BIPM in Sèvres (Francis and van Dam, 2003). Geophysical corrections are applied to the raw gravity data: Earth tides using observed tidal parameters, atmospheric pressure effect using a constant admittance, and the polar motion effect using pole positions from IERS.

The g-soft version 7.0 software from Microg-LaCoste Inc. was used for the processing. All the text outputs as well as some figures are compiled in the annexes of this report for future reference.

1.2 Vertical Gravity Gradient

The vertical gravity gradient is needed to linearize the equation of motion but also to transfer the measured absolute gravity value from the reference height around 1.3 m to the floor. We measured the gravity difference between two different levels above the benchmark

about 1 meter apart. We obtained a value -2.752 ± 0.013 microGal/cm for the vertical gravity gradient.

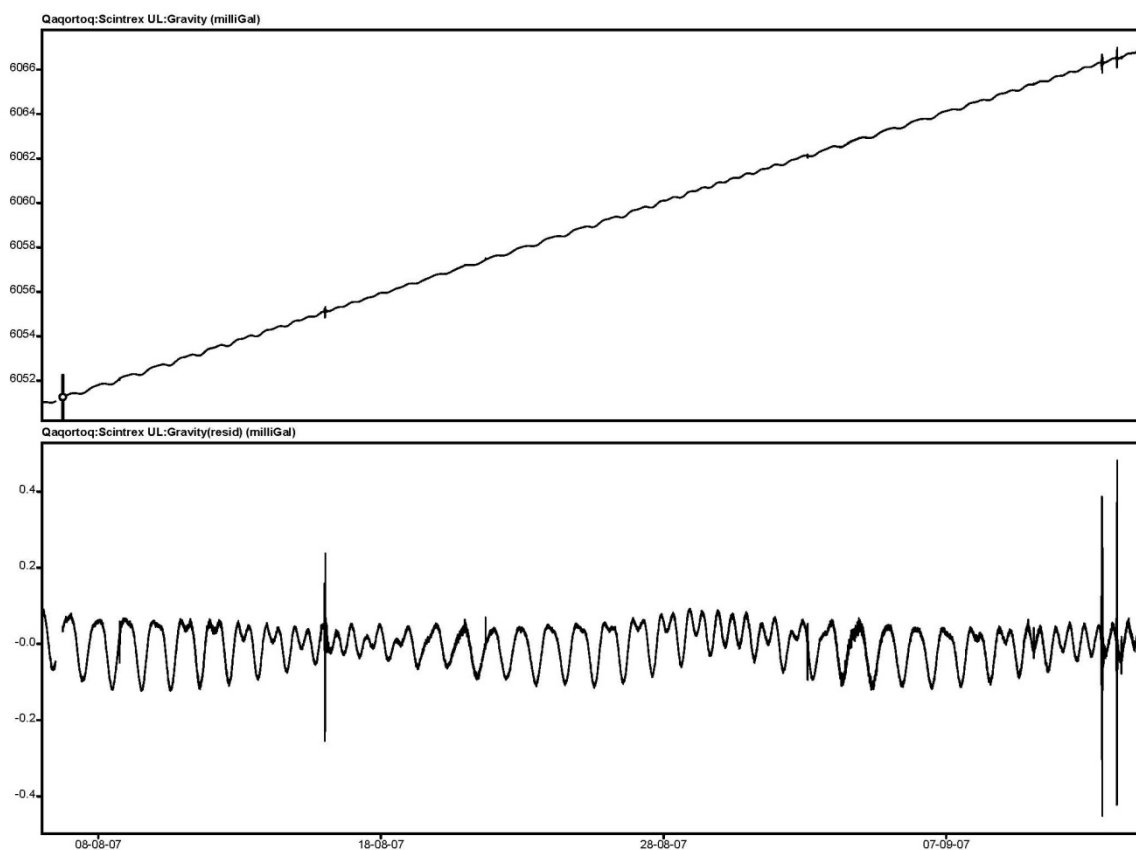
1.3 Tidal corrections

At coastal stations, it is very difficult to model accurately the ocean loading tides due to the proximity of the ocean. We decided to use observed tidal parameters instead of using models for the body and oceanic loading tides to generate the tides corrections. For that purpose, we recorded (and are still recording at the time of this present report) the gravity tides with a spring gravimeter Scintrex CG5 (Figure 3).



Figure 3. The Scintrex CG5 (University of Luxembourg) with its data acquisition system including records of the barometric pressure, temperature and relative humidity.

At this stage, we analyzed 33 days of data (Figures 4). The estimated tidal parameters (Table 1) have been used to correct the FG5 observations. At the time of this report, the Scintrex is still recording the gravity tides in Qaqortoq for at least one full year.

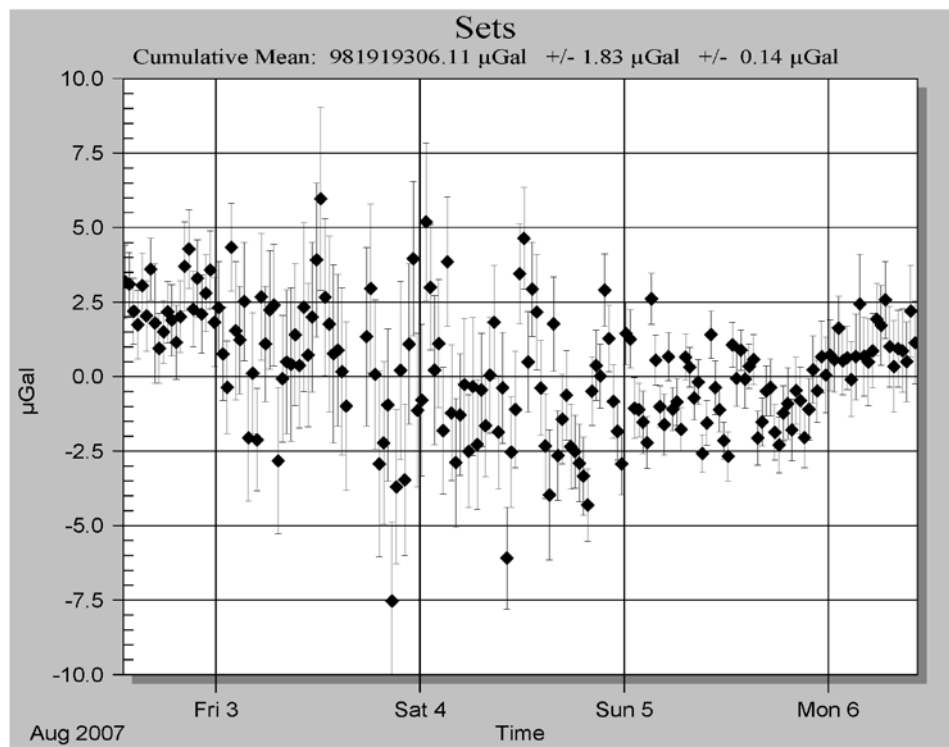
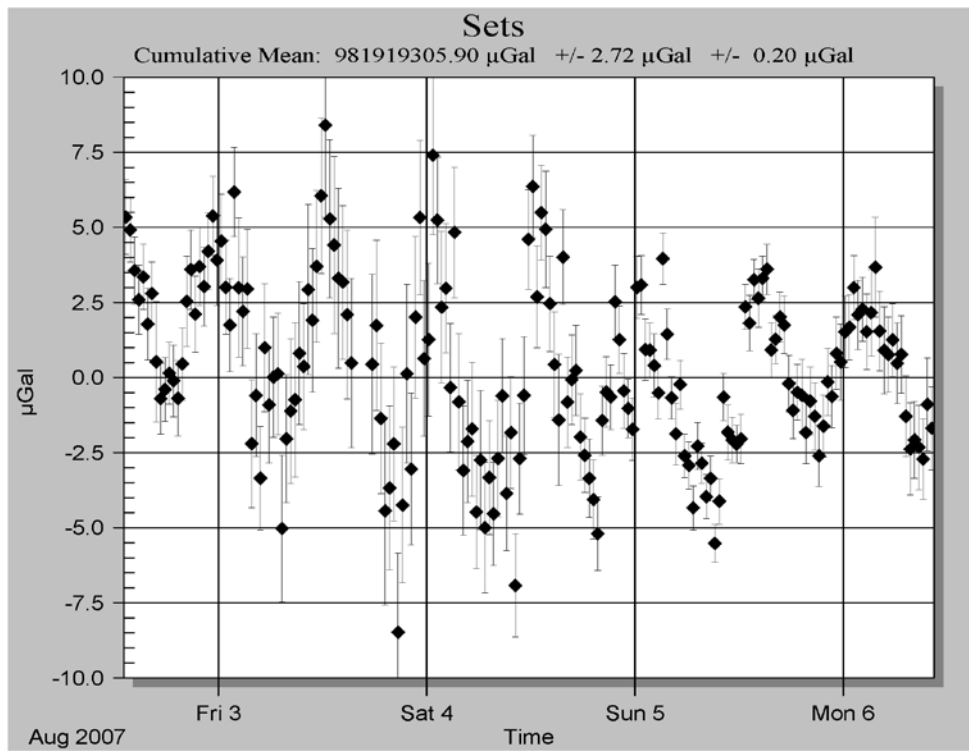


Figures 4. The first 33-day of registration of the spring gravimeter Scintrex CG5 (S/N021210010) from the University of Luxembourg in Qaqortoq. The top figure shows the raw minute data. The bottom one shows the same data after removing a 3rd degree polynomial.

Table 1. Observed tidal parameters (delta factor and phase alpha) estimated using a record of 33-day with the spring gravimeter Scintrex CG5 (S/N021210010) from the University of Luxembourg. The gravimeter was installed in the Tele Greenland building in Qaqortoq. For the DC, long-periods, M_3 and M_4 tides, the theoretical values have been used.

Wave	from (cpd)	To (cpd)	Amplitude Factor	Phase Lead (degree)
DC	0.000000	0.002427	1.00000	0.0000
Long Periods	0.002428	0.249951	1.16000	0.0000
Q_1	0.721500	0.906315	1.17782	1.3016
O_1	0.921941	0.940487	1.17182	1.3174
M_1	0.958085	0.974188	1.19655	-1.2894
K_1	0.989049	1.011099	1.16486	2.4518
J_1	1.013689	1.044800	1.0659	4.1713
OO_1	1.064841	1.216397	1.27496	-6.8453
$2N_2$	1.719381	1.872142	1.41350	18.5026
N_2	1.888387	1.906462	1.50668	6.0474
M_2	1.923766	1.942754	1.54067	1.9179
L_2	1.958233	1.976926	1.77619	-5.4127
S_2	1.991787	2.182843	1.44034	-5.604
M_3	2.753244	3.081254	1.07338	0.0000
M_4	3.791964	3.937897	1.03900	0.0000

In Figures 5, the first plot shows the set gravity values corrected for a theoretical body tide and a modelled gravitational attraction and elastic loading gravity effects. A tidal signal is still visible. The second plot shows the same data corrected for a synthetic tidal prediction using the observed tidal parameters. The improvement in removing the tidal signal is obvious. The standard deviation significantly drops from 2.72 microgal to 1.83 microgal. However, we also detect more easily the noisier period from the 3rd to the 4th of August 2007 due to the wind and sea conditions at that time. This is typical noise variations at a coastal station.



Figures 5. Comparison of the set values corrected using a synthetic tides based on modelled tides on top and on the observed tidal parameters on the bottom.

1.4 Results of the absolute gravity measurements

The FG5#216 was set-up on Friday 3rd of August until Tuesday 7 of August 2007. A total of 183 sets of 150 drops every 5 seconds were taken with a rate of 2 set per hour. It represents a total of 27450 drops!

Site	Gravity value /microgal	Standard Deviation /microgal
Qaqortoq - Absolute site @ 1.3 m	981 919 306.11	1.83
Qaqortoq - Absolute site @ the floor (top of the brass)	981 919 663.87	2.49

2. Relative measurements

A small gravity network has been measured including the absolute gravity site, the site 88204 from the National Gravity Net and two additional new sites (Figures 6).



Absolute gravity site in the Tele Greenland Building



Site 88204 of the National Gravity Net



The 'snake' boulder



The old Church

Figures 6. Sites of the relative network measured in Qaqortoq.

The results of the gravity ties are given in Table 2.

Table 2. Relative ties in Qaqortoq.

Site	Code	gravity difference/ microGal	RMS microGal
Absolute gravity site (Tele Greenland)		0	
National Gravity Net	88204	5364.1	1.5
The old Church		5984.0	1.8
The 'snake' boulder		5033.4	1.9

Reference

Francis O., van Dam T.M., Processing of the Absolute data of the ICAG01, Cahiers du Centre Européen de Géodynamique et de Séismologie, vol.22, 45-48, 2003.

ANNEXES

STATION: QAQORTOQ			
City:	Qaqortoq	Country:	Greenland
Location:	Tele Greenland	Particularity:	
Situation:	Storage Room	Remarks:	
Date:	02-06 August 2007		
Code number:			
Latitude:	60.71648 degrees		
Longitude:	-46.04332 degrees		
Elevation:	33.0 m		
Gradient:	-2.752 µgal/cm		
Reference height: 0. 1250 m + 1.1652 m = 1.2902m			
Meter:	FG5		
S/N:	216		
Tidal corrections using observed tidal parameters			
Polar motion correction			Air pressure correction
X-coordinate	0.2260	arc seconds	Nominal air pressure: 1009.29 mbar
Y-coordinate	0.3266	arc seconds	Barometric admittance factor: 0.3 µgal/mbar
Gravity			
Set gravity mean:	981 919 306.11	Microgal	
Set std. dev.:	1.83	microgal	
Mean std. dev.:	19.16	microgal	
Number of sets:	183		
Number of drops per set:	150		
Drop interval:	5 seconds		
Set interval:	30 minutes		
Nominal/datum height:	1.30 m		
Author: O. Francis	University of Luxembourg		
Date: October 22, 2007			

Project file

Micro-g Solutions g Processing Report
File Created: 10/04/07, 14:25:41

Project Name: qa200708
g Acquisition Version: 1.082300
g Processing Version: 7.070307

Company/Institution: University of Luxembourg
Operator: Olivier FRANCIS

Station Data

Name: QAQORTOQ
Site Code: Tele Greenland Building
Lat: 60.71648 Long: -46.04332 Elev: 33.00 m
Setup Height: 12.50 cm
Transfer Height: 130.00 cm
Actual Height: 129.02 cm
Gradient: -2.752 $\mu\text{Gal}/\text{cm}$
Nominal Air Pressure: 1009.29 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.2260 " 0.3266 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\Program Files\Micro-g Solutions
Inc\gWavefiles\Etcpot.dat
Delta Factor Filename: F:\ABSOLU\DATA\INI\qaqortoq.ini
Delta Factors

Start	Stop	Amplitude	Phase	Term
0.000000	0.002427	1.00000	0.0000	DC
0.002428	0.249951	1.16000	0.0000	LONG
0.7215	0.906315	1.17782	1.3016	Q1
0.921941	0.940487	1.17182	1.3174	O1
0.958085	0.974188	1.19655	-1.2894	M1
0.989049	1.011099	1.16486	2.4518	K1
1.013689	1.0448	1.0659	4.1713	J1
1.064841	1.216397	1.27496	-6.8453	OO1
1.719381	1.872142	1.4135	18.5026	2N2
1.888387	1.906462	1.50668	6.0474	N2
1.923766	1.942754	1.54067	1.9179	M2
1.958233	1.976926	1.77619	-5.4127	L2
1.991787	2.182843	1.44034	-5.604	S2
2.753244	3.081254	1.07338	0.0000	M3
3.791964	3.937897	1.03900	0.0000	M4

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 116.52 cm
Rubidium Frequency: 10000000.00900 Hz
Laser: WEO100 (187)
ID: 632.99117754 nm (0.30 V)
IE: 632.99119473 nm (-0.17 V)
IF: 632.99121259 nm (-0.56 V)
IG: 632.99123023 nm (-0.94 V)
IH: 632.99136890 nm (-1.70 V)
II: 632.99139822 nm (-1.53 V)
IJ: 632.99142704 nm (-1.36 V)
Modulation Frequency: 8333.420 Hz

Processing Results

Date: 08/04/07

Time: 12:10:17
 DOY: 216
 Year: 2007
 Time Offset (D h:m:s): 0 0:0:0
 Gravity: 981919306.11 μGal
 Set Scatter: 1.83 μGal
 Measurement Precision: 0.14 μGal
 Total Uncertainty: 0.14 μGal
 Number of Sets Collected: 183
 Number of Sets Processed: 183
 Set #s Processed:
 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,
 29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,
 54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,
 79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,
 103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,
 122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,14
 0,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,1
 59,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,
 178,179,180,181,182,183
 Number of Sets NOT Processed: 0
 Set #s NOT Processed:
 Number of Drops/Set: 150
 Total Drops Accepted: 27183
 Total Drops Rejected: 267
 Total Fringes Acquired: 700
 Fringe Start: 7
 Processed Fringes: 613
 GuideCard Multiplex: 4
 GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 30 min
 Drop Interval: 5 sec
 Number of Sets: 183
 Number of Drops: 150

Gravity Corrections

Earth Tide (ETGTAB): -44.44 μGal
 Polar Motion: -6.40 μGal
 Barometric Pressure: -2.11 μGal
 Transfer Height: -2.70 μGal
 Reference Xo: -0.80 μGal

Uncertainties

Sigma Reject: 3.00
 Earth Tide Factor: 0.000
 Average Earth Tide Uncertainty: 0.00 μGal
 Ocean Load Factor: 0.00
 Average Ocean Load Uncertainty: 0.00 μGal
 Barometric: 0.00 μGal
 Polar Motion: 0.00 μGal
 Laser: 0.00 μGal
 Clock: 0.00 μGal
 System Type: 0.00 μGal
 Tidal Swell: 0.00 μGal
 Water Table: 0.00 μGal
 Unmodeled: 0.00 μGal
 System Setup: 0.00 μGal
 Gradient: 0.00 μGal (0.00 $\mu\text{Gal}/\text{cm}$)

Comments: Files Merged: qa20070802.fg5 qa20070803.fg5

Set File

Source Data Filename: qa200708

g Acquisition Version: 1.082300

g Processing Version: 7.070307

Set	Time	DOY	Year	Gravity	Sigma	Error	Uncert	Tide	Load	Baro	Polar	Transfer	Refxo	Temp	Pres	Accept	Reject
1	13:20:05	214	2007	981919309.284	14.895	1.237	1.237	-53.070	0.000	-3.511	-6.400	-2.697	-0.805	24.551	997.586	145	5
2	13:49:56	214	2007	981919309.201	12.830	1.062	1.062	-43.402	0.000	-3.535	-6.400	-2.697	-0.815	24.825	997.505	146	4
3	14:20:03	214	2007	981919308.299	13.395	1.109	1.109	-33.429	0.000	-3.563	-6.400	-2.697	-0.815	24.964	997.414	146	4
4	14:49:59	214	2007	981919307.841	13.976	1.149	1.149	-23.913	0.000	-3.608	-6.400	-2.697	-0.811	24.925	997.265	148	2
5	15:20:02	214	2007	981919309.162	13.139	1.080	1.080	-15.349	0.000	-3.670	-6.400	-2.697	-0.814	24.844	997.055	148	2
6	15:49:39	214	2007	981919308.141	14.025	1.190	1.190	-8.416	0.000	-3.661	-6.400	-2.697	-0.801	24.745	997.088	139	11
7	16:20:08	214	2007	981919309.709	12.572	1.048	1.048	-3.319	0.000	-3.680	-6.400	-2.697	-0.811	24.841	997.022	144	6
8	16:49:56	214	2007	981919307.898	24.173	2.001	2.001	-0.686	0.000	-3.683	-6.400	-2.697	-0.807	24.785	997.012	146	4
9	17:20:15	214	2007	981919307.048	14.119	1.177	1.177	-0.609	0.000	-3.688	-6.400	-2.697	-0.799	24.939	996.996	144	6
10	17:50:01	214	2007	981919307.606	12.926	1.059	1.059	-3.155	0.000	-3.676	-6.400	-2.697	-0.821	24.971	997.037	149	1
11	18:20:01	214	2007	981919308.274	12.525	1.030	1.030	-8.261	0.000	-3.662	-6.400	-2.697	-0.806	24.975	997.084	148	2
12	18:50:02	214	2007	981919307.999	14.624	1.198	1.198	-15.679	0.000	-3.668	-6.400	-2.697	-0.825	25.003	997.064	149	1
13	19:20:02	214	2007	981919307.255	15.237	1.248	1.248	-25.035	0.000	-3.623	-6.400	-2.697	-0.808	25.043	997.214	149	1
14	19:50:00	214	2007	981919308.112	14.644	1.196	1.196	-35.824	0.000	-3.562	-6.400	-2.697	-0.804	25.019	997.416	150	0
15	20:20:07	214	2007	981919309.806	18.038	1.498	1.498	-47.538	0.000	-3.540	-6.400	-2.697	-0.807	25.141	997.492	145	5
16	20:50:00	214	2007	981919310.383	16.204	1.327	1.327	-59.413	0.000	-3.500	-6.400	-2.697	-0.811	25.100	997.623	149	1
17	21:19:58	214	2007	981919308.361	15.452	1.266	1.266	-70.924	0.000	-3.464	-6.400	-2.697	-0.796	24.944	997.744	149	1
18	21:50:00	214	2007	981919309.400	15.840	1.298	1.298	-81.442	0.000	-3.484	-6.400	-2.697	-0.795	24.806	997.677	149	1
19	22:20:01	214	2007	981919308.200	15.859	1.308	1.308	-90.376	0.000	-3.385	-6.400	-2.697	-0.795	24.717	998.007	147	3
20	22:50:00	214	2007	981919308.902	15.705	1.287	1.287	-97.258	0.000	-3.328	-6.400	-2.697	-0.806	24.652	998.196	149	1
21	23:19:54	214	2007	981919309.679	15.760	1.313	1.313	-101.740	0.000	-3.308	-6.400	-2.697	-0.798	24.577	998.264	144	6
22	23:50:00	214	2007	981919307.928	18.248	1.495	1.495	-103.636	0.000	-3.284	-6.400	-2.697	-0.818	24.582	998.343	149	1
23	00:20:02	215	2007	981919308.415	18.888	1.553	1.553	-102.857	0.000	-3.239	-6.400	-2.697	-0.806	24.606	998.492	148	2
24	00:50:01	215	2007	981919306.864	19.071	1.568	1.568	-99.513	0.000	-3.219	-6.400	-2.697	-0.806	24.578	998.560	148	2
25	01:20:00	215	2007	981919305.741	18.882	1.552	1.552	-93.847	0.000	-3.205	-6.400	-2.697	-0.811	24.558	998.605	148	2
26	01:50:01	215	2007	981919310.443	18.062	1.480	1.480	-86.219	0.000	-3.141	-6.400	-2.697	-0.805	24.550	998.821	149	1
27	02:20:00	215	2007	981919307.641	28.386	2.318	2.318	-77.136	0.000	-3.100	-6.400	-2.697	-0.809	24.518	998.955	150	0
28	02:50:01	215	2007	981919307.334	21.976	1.806	1.806	-67.139	0.000	-3.127	-6.400	-2.697	-0.819	24.491	998.868	148	2
29	03:19:59	215	2007	981919308.624	24.279	1.989	1.989	-56.849	0.000	-3.130	-6.400	-2.697	-0.789	24.479	998.858	149	1
30	03:49:58	215	2007	981919304.045	25.611	2.127	2.127	-46.855	0.000	-3.123	-6.400	-2.697	-0.795	24.446	998.880	145	5
31	04:20:01	215	2007	981919306.217	24.959	2.045	2.045	-37.713	0.000	-3.077	-6.400	-2.697	-0.791	24.392	999.034	149	1
32	04:50:01	215	2007	981919303.983	20.932	1.721	1.721	-29.969	0.000	-3.047	-6.400	-2.697	-0.809	24.373	999.134	148	2
33	05:20:01	215	2007	981919308.776	26.125	2.133	2.133	-24.007	0.000	-2.980	-6.400	-2.697	-0.800	24.333	999.357	150	0
34	05:50:01	215	2007	981919307.206	23.692	1.934	1.934	-20.102	0.000	-2.909	-6.400	-2.697	-0.795	24.318	999.594	150	0
35	06:20:04	215	2007	981919308.338	24.293	1.997	1.997	-18.395	0.000	-2.912	-6.400	-2.697	-0.799	24.310	999.584	148	2
36	06:50:01	215	2007	981919308.508	24.896	2.033	2.033	-18.877	0.000	-2.862	-6.400	-2.697	-0.799	24.308	999.751	150	0
37	07:19:57	215	2007	981919303.280	29.620	2.451	2.451	-21.386	0.000	-2.811	-6.400	-2.697	-0.792	24.288	999.919	146	4
38	07:50:02	215	2007	981919306.036	25.857	2.125	2.125	-25.667	0.000	-2.783	-6.400	-2.697	-0.787	24.278	1000.013	148	2
39	08:20:00	215	2007	981919306.599	28.922	2.410	2.410	-31.290	0.000	-2.795	-6.400	-2.697	-0.800	24.282	999.972	144	6
40	08:50:01	215	2007	981919306.511	31.565	2.577	2.577	-37.806	0.000	-2.761	-6.400	-2.697	-0.787	24.265	1000.086	150	0
41	09:20:03	215	2007	981919307.509	28.945	2.379	2.379	-44.703	0.000	-2.744	-6.400	-2.697	-0.798	24.247	1000.144	148	2

42 09:50:02	215	2007 981919306.476 25.663	2.102	2.102	-51.428	0.000	-2.737	-6.400	-2.697	-0.811	24.219	1000.168	149	1
43 10:19:59	215	2007 981919308.431 34.576	2.833	2.833	-57.496	0.000	-2.750	-6.400	-2.697	-0.814	24.238	1000.125	149	1
44 10:50:01	215	2007 981919306.825 29.269	2.398	2.398	-62.483	0.000	-2.714	-6.400	-2.697	-0.797	24.204	1000.242	149	1
45 11:20:01	215	2007 981919308.101 30.704	2.515	2.515	-66.030	0.000	-2.702	-6.400	-2.697	-0.796	24.169	1000.284	149	1
46 11:50:01	215	2007 981919310.021 31.637	2.583	2.583	-67.907	0.000	-2.727	-6.400	-2.697	-0.786	24.169	1000.200	150	0
47 12:20:02	215	2007 981919312.065 37.546	3.076	3.076	-68.011	0.000	-2.731	-6.400	-2.697	-0.790	24.411	1000.186	149	1
48 12:50:01	215	2007 981919308.771 32.340	2.641	2.641	-66.375	0.000	-2.757	-6.400	-2.697	-0.790	24.187	1000.101	150	0
49 13:19:58	215	2007 981919307.868 35.556	2.943	2.943	-63.160	0.000	-2.751	-6.400	-2.697	-0.805	24.404	1000.121	146	4
50 13:50:00	215	2007 981919306.871 36.340	2.987	2.987	-58.631	0.000	-2.743	-6.400	-2.697	-0.790	24.460	1000.147	148	2
51 14:19:59	215	2007 981919306.991 31.055	2.553	2.553	-53.177	0.000	-2.748	-6.400	-2.697	-0.796	24.494	1000.130	148	2
52 14:50:01	215	2007 981919306.270 34.416	2.810	2.810	-47.226	0.000	-2.759	-6.400	-2.697	-0.785	24.403	1000.094	150	0
53 15:19:59	215	2007 981919305.113 34.429	2.821	2.821	-41.276	0.000	-2.781	-6.400	-2.697	-0.800	24.319	1000.019	149	1
54 17:43:10	215	2007 981919307.448 36.134	2.991	2.991	-26.629	0.000	-2.657	-6.400	-2.697	-0.797	24.210	1000.432	146	4
55 18:13:02	215	2007 981919309.061 34.598	2.834	2.834	-28.455	0.000	-2.672	-6.400	-2.697	-0.803	24.658	1000.384	149	1
56 18:43:05	215	2007 981919306.175 30.464	2.504	2.504	-32.221	0.000	-2.657	-6.400	-2.697	-0.797	24.728	1000.433	148	2
57 19:13:02	215	2007 981919303.173 38.022	3.115	3.115	-37.760	0.000	-2.602	-6.400	-2.697	-0.790	24.678	1000.616	149	1
58 19:43:04	215	2007 981919303.876 33.183	2.728	2.728	-44.847	0.000	-2.581	-6.400	-2.697	-0.789	24.605	1000.686	148	2
59 20:13:00	215	2007 981919305.152 31.347	2.559	2.559	-53.078	0.000	-2.563	-6.400	-2.697	-0.811	24.494	1000.747	150	0
60 20:42:59	215	2007 981919298.576 32.100	2.630	2.630	-62.031	0.000	-2.613	-6.400	-2.697	-0.786	24.428	1000.580	149	1
61 21:13:01	215	2007 981919302.405 31.631	2.591	2.591	-71.210	0.000	-2.600	-6.400	-2.697	-0.786	24.385	1000.622	149	1
62 21:43:01	215	2007 981919306.312 36.393	2.981	2.981	-80.050	0.000	-2.639	-6.400	-2.697	-0.794	24.336	1000.493	149	1
63 22:13:00	215	2007 981919302.638 30.817	2.533	2.533	-88.036	0.000	-2.626	-6.400	-2.697	-0.791	24.307	1000.536	148	2
64 22:42:55	215	2007 981919307.198 32.634	2.692	2.692	-94.659	0.000	-2.522	-6.400	-2.697	-0.792	24.287	1000.883	147	3
65 23:13:00	215	2007 981919310.058 31.612	2.581	2.581	-99.536	0.000	-2.489	-6.400	-2.697	-0.802	24.346	1000.994	150	0
66 23:43:01	215	2007 981919304.971 31.546	2.584	2.584	-102.282	0.000	-2.450	-6.400	-2.697	-0.801	24.282	1001.122	149	1
67 00:13:00	216	2007 981919305.314 31.231	2.550	2.550	-102.688	0.000	-2.481	-6.400	-2.697	-0.792	24.259	1001.020	150	0
68 00:43:02	216	2007 981919311.296 32.186	2.637	2.637	-100.656	0.000	-2.461	-6.400	-2.697	-0.797	24.252	1001.088	149	1
69 01:13:01	216	2007 981919309.102 25.663	2.110	2.110	-96.227	0.000	-2.423	-6.400	-2.697	-0.800	24.241	1001.213	148	2
70 01:42:58	216	2007 981919306.322 30.563	2.512	2.512	-89.577	0.000	-2.429	-6.400	-2.697	-0.790	24.261	1001.192	148	2
71 02:13:05	216	2007 981919307.210 25.789	2.149	2.149	-80.938	0.000	-2.358	-6.400	-2.697	-0.806	24.298	1001.431	144	6
72 02:43:00	216	2007 981919304.292 26.009	2.131	2.131	-70.817	0.000	-2.356	-6.400	-2.697	-0.799	24.312	1001.435	149	1
73 03:12:59	216	2007 981919309.961 26.397	2.177	2.177	-59.620	0.000	-2.304	-6.400	-2.697	-0.782	24.382	1001.611	147	3
74 03:42:56	216	2007 981919304.883 27.250	2.271	2.271	-47.912	0.000	-2.309	-6.400	-2.697	-0.799	24.373	1001.593	144	6
75 04:12:57	216	2007 981919303.218 26.147	2.157	2.157	-36.226	0.000	-2.239	-6.400	-2.697	-0.781	24.398	1001.827	147	3
76 04:43:01	216	2007 981919304.817 24.862	2.037	2.037	-25.122	0.000	-2.181	-6.400	-2.697	-0.791	24.424	1002.021	149	1
77 05:13:00	216	2007 981919305.835 27.256	2.225	2.225	-15.171	0.000	-2.104	-6.400	-2.697	-0.793	24.338	1002.275	150	0
78 05:43:02	216	2007 981919303.601 23.143	1.896	1.896	-6.774	0.000	-2.027	-6.400	-2.697	-0.809	24.307	1002.532	149	1
79 06:13:00	216	2007 981919305.767 28.222	2.312	2.312	-0.307	0.000	-1.962	-6.400	-2.697	-0.796	24.276	1002.750	149	1
80 06:42:58	216	2007 981919303.825 26.601	2.179	2.179	4.012	0.000	-1.936	-6.400	-2.697	-0.796	24.255	1002.838	149	1
81 07:13:00	216	2007 981919305.658 23.229	1.903	1.903	6.074	0.000	-1.885	-6.400	-2.697	-0.792	24.268	1003.005	149	1
82 07:43:00	216	2007 981919304.457 21.029	1.717	1.717	5.890	0.000	-1.798	-6.400	-2.697	-0.805	24.278	1003.298	150	0
83 08:13:00	216	2007 981919306.152 23.712	1.936	1.936	3.608	0.000	-1.738	-6.400	-2.697	-0.789	24.340	1003.496	150	0
84 08:43:00	216	2007 981919307.930 23.374	1.908	1.908	-0.512	0.000	-1.652	-6.400	-2.697	-0.793	24.323	1003.782	150	0
85 09:12:58	216	2007 981919304.244 23.099	1.899	1.899	-6.111	0.000	-1.531	-6.400	-2.697	-0.787	24.318	1004.187	148	2
86 09:43:00	216	2007 981919305.726 22.769	1.859	1.859	-12.798	0.000	-1.456	-6.400	-2.697	-0.793	24.321	1004.435	150	0
87 10:13:00	216	2007 981919300.015 21.006	1.715	1.715	-20.090	0.000	-1.405	-6.400	-2.697	-0.770	24.264	1004.606	150	0
88 10:43:01	216	2007 981919303.572 22.657	1.850	1.850	-27.534	0.000	-1.293	-6.400	-2.697	-0.789	24.241	1004.980	150	0
89 11:13:01	216	2007 981919305.001 24.032	1.962	1.962	-34.691	0.000	-1.207	-6.400	-2.697	-0.790	24.224	1005.267	150	0
90 11:42:59	216	2007 981919309.555 20.263	1.660	1.660	-41.169	0.000	-1.043	-6.400	-2.697	-0.794	24.258	1005.813	149	1
91 12:13:01	216	2007 981919310.741 20.857	1.703	1.703	-46.677	0.000	-0.979	-6.400	-2.697	-0.791	24.445	1006.026	150	0

92 12:43:01	216	2007 981919306.593 20.741	1.694	1.694	-50.977	0.000	-0.897	-6.400	-2.697	-0.794	24.430	1006.298	150	0
93 13:13:01	216	2007 981919309.040 19.417	1.585	1.585	-53.963	0.000	-0.769	-6.400	-2.697	-0.807	24.373	1006.728	150	0
94 13:43:02	216	2007 981919308.268 23.653	1.938	1.938	-55.630	0.000	-0.675	-6.400	-2.697	-0.798	24.359	1007.042	149	1
95 14:13:01	216	2007 981919305.719 19.494	1.592	1.592	-56.072	0.000	-0.626	-6.400	-2.697	-0.799	24.340	1007.202	150	0
96 14:43:01	216	2007 981919303.772 21.479	1.754	1.754	-55.483	0.000	-0.637	-6.400	-2.697	-0.810	24.326	1007.167	150	0
97 15:13:01	216	2007 981919302.131 26.751	2.184	2.184	-54.124	0.000	-0.605	-6.400	-2.697	-0.791	24.274	1007.273	150	0
98 15:42:57	216	2007 981919307.872 19.025	1.580	1.580	-52.317	0.000	-0.630	-6.400	-2.697	-0.796	24.245	1007.189	145	5
99 16:13:01	216	2007 981919303.456 18.381	1.506	1.506	-50.396	0.000	-0.661	-6.400	-2.697	-0.785	24.229	1007.085	149	1
100 16:42:59	216	2007 981919304.676 18.311	1.500	1.500	-48.721	0.000	-0.605	-6.400	-2.697	-0.790	24.254	1007.273	149	1
101 17:13:01	216	2007 981919305.479 18.479	1.509	1.509	-47.606	0.000	-0.540	-6.400	-2.697	-0.804	24.257	1007.492	150	0
102 17:43:01	216	2007 981919303.753 17.489	1.428	1.428	-47.329	0.000	-0.460	-6.400	-2.697	-0.797	24.278	1007.758	150	0
103 18:13:01	216	2007 981919303.589 15.084	1.232	1.232	-48.098	0.000	-0.371	-6.400	-2.697	-0.792	24.266	1008.054	150	0
104 18:43:01	216	2007 981919303.197 15.909	1.299	1.299	-50.034	0.000	-0.386	-6.400	-2.697	-0.792	24.264	1008.005	150	0
105 19:13:00	216	2007 981919302.767 16.008	1.316	1.316	-53.168	0.000	-0.364	-6.400	-2.697	-0.791	24.242	1008.077	148	2
106 19:43:04	216	2007 981919301.797 14.816	1.222	1.222	-57.444	0.000	-0.326	-6.400	-2.697	-0.797	24.216	1008.203	147	3
107 20:13:02	216	2007 981919305.615 13.909	1.151	1.151	-62.679	0.000	-0.321	-6.400	-2.697	-0.793	24.180	1008.221	146	4
108 20:43:01	216	2007 981919306.481 14.409	1.177	1.177	-68.640	0.000	-0.305	-6.400	-2.697	-0.794	24.134	1008.275	150	0
109 21:13:01	216	2007 981919306.121 13.213	1.079	1.079	-75.013	0.000	-0.371	-6.400	-2.697	-0.787	24.121	1008.053	150	0
110 21:43:01	216	2007 981919309.004 14.894	1.220	1.220	-81.425	0.000	-0.351	-6.400	-2.697	-0.799	24.217	1008.118	149	1
111 22:13:01	216	2007 981919307.384 13.703	1.119	1.119	-87.472	0.000	-0.382	-6.400	-2.697	-0.790	24.216	1008.016	150	0
112 22:43:01	216	2007 981919305.273 15.245	1.245	1.245	-92.747	0.000	-0.369	-6.400	-2.697	-0.785	24.208	1008.060	150	0
113 23:13:01	216	2007 981919304.269 11.934	0.974	0.974	-96.858	0.000	-0.419	-6.400	-2.697	-0.794	24.175	1007.894	150	0
114 23:43:04	216	2007 981919303.173 12.622	1.038	1.038	-99.459	0.000	-0.411	-6.400	-2.697	-0.787	24.122	1007.921	148	2
115 00:13:01	217	2007 981919307.546 12.723	1.039	1.039	-100.253	0.000	-0.330	-6.400	-2.697	-0.787	24.069	1008.190	150	0
116 00:43:02	217	2007 981919307.362 11.833	0.976	0.976	-99.046	0.000	-0.431	-6.400	-2.697	-0.792	24.030	1007.853	147	3
117 01:13:01	217	2007 981919305.047 12.507	1.021	1.021	-95.730	0.000	-0.545	-6.400	-2.697	-0.801	24.028	1007.474	150	0
118 01:42:59	217	2007 981919304.992 10.933	0.896	0.896	-90.302	0.000	-0.505	-6.400	-2.697	-0.796	24.034	1007.607	149	1
119 02:13:02	217	2007 981919304.574 12.732	1.043	1.043	-82.851	0.000	-0.658	-6.400	-2.697	-0.781	24.053	1007.096	149	1
120 02:43:02	217	2007 981919303.885 10.432	0.860	0.860	-73.609	0.000	-0.691	-6.400	-2.697	-0.789	24.038	1006.988	147	3
121 03:13:01	217	2007 981919308.713 10.498	0.857	0.857	-62.886	0.000	-0.772	-6.400	-2.697	-0.786	24.043	1006.715	150	0
122 03:43:01	217	2007 981919306.657 10.298	0.841	0.841	-51.049	0.000	-0.876	-6.400	-2.697	-0.785	24.054	1006.370	150	0
123 04:13:00	217	2007 981919305.093 8.570	0.702	0.702	-38.556	0.000	-0.844	-6.400	-2.697	-0.783	24.076	1006.478	149	1
124 04:42:58	217	2007 981919304.494 12.387	1.025	1.025	-25.907	0.000	-0.959	-6.400	-2.697	-0.838	24.033	1006.094	146	4
125 05:12:59	217	2007 981919306.770 9.886	0.810	0.810	-13.567	0.000	-1.079	-6.400	-2.697	-0.785	23.994	1005.692	149	1
126 05:43:04	217	2007 981919305.010 8.929	0.734	0.734	-2.018	0.000	-1.133	-6.400	-2.697	-0.792	23.976	1005.513	148	2
127 06:12:59	217	2007 981919305.257 9.596	0.786	0.786	8.208	0.000	-1.177	-6.400	-2.697	-0.780	23.965	1005.365	149	1
128 06:43:01	217	2007 981919304.327 9.052	0.739	0.739	16.834	0.000	-1.301	-6.400	-2.697	-0.804	23.978	1004.953	150	0
129 07:13:01	217	2007 981919306.753 9.533	0.778	0.778	23.509	0.000	-1.344	-6.400	-2.697	-0.789	23.987	1004.810	150	0
130 07:42:58	217	2007 981919306.418 8.121	0.668	0.668	28.037	0.000	-1.404	-6.400	-2.697	-0.788	24.003	1004.609	148	2
131 08:13:01	217	2007 981919305.385 8.991	0.734	0.734	30.336	0.000	-1.443	-6.400	-2.697	-0.794	24.012	1004.481	150	0
132 08:43:01	217	2007 981919305.921 9.184	0.750	0.750	30.408	0.000	-1.495	-6.400	-2.697	-0.797	24.038	1004.307	150	0
133 09:12:59	217	2007 981919303.520 7.580	0.625	0.625	28.377	0.000	-1.558	-6.400	-2.697	-0.793	24.038	1004.097	147	3
134 09:43:00	217	2007 981919304.545 9.180	0.755	0.755	24.449	0.000	-1.613	-6.400	-2.697	-0.783	24.033	1003.914	148	2
135 10:12:59	217	2007 981919307.513 9.506	0.781	0.781	18.918	0.000	-1.677	-6.400	-2.697	-0.795	24.018	1003.700	148	2
136 10:43:01	217	2007 981919305.731 11.084	0.905	0.905	12.122	0.000	-1.719	-6.400	-2.697	-0.780	23.984	1003.561	150	0
137 11:12:57	217	2007 981919304.991 8.894	0.734	0.734	4.470	0.000	-1.809	-6.400	-2.697	-0.788	24.007	1003.260	147	3
138 11:43:02	217	2007 981919303.954 7.565	0.620	0.620	-3.710	0.000	-1.826	-6.400	-2.697	-0.791	24.032	1003.204	149	1
139 12:13:02	217	2007 981919303.428 9.930	0.825	0.825	-11.978	0.000	-1.917	-6.400	-2.697	-0.784	24.047	1002.900	145	5
140 12:42:57	217	2007 981919307.172 9.081	0.746	0.746	-19.996	0.000	-1.945	-6.400	-2.697	-0.793	24.065	1002.805	148	2
141 13:13:02	217	2007 981919306.040 11.304	0.926	0.926	-27.537	0.000	-2.039	-6.400	-2.697	-0.779	24.297	1002.493	149	1

142 13:43:01	217	2007 981919306.994 8.169	0.674	0.674	-34.320	0.000	-2.119	-6.400	-2.697	-0.805	24.374	1002.228	147	3
143 14:13:10	217	2007 981919306.019 11.737	0.971	0.971	-40.252	0.000	-2.168	-6.400	-2.697	-0.791	24.238	1002.062	146	4
144 14:43:01	217	2007 981919306.450 9.171	0.749	0.749	-45.188	0.000	-2.218	-6.400	-2.697	-0.796	24.367	1001.896	150	0
145 15:13:01	217	2007 981919306.674 10.237	0.836	0.836	-49.221	0.000	-2.293	-6.400	-2.697	-0.802	24.392	1001.645	150	0
146 15:43:01	217	2007 981919304.045 11.175	0.912	0.912	-52.405	0.000	-2.345	-6.400	-2.697	-0.798	24.383	1001.473	150	0
147 16:13:01	217	2007 981919304.586 9.795	0.800	0.800	-54.881	0.000	-2.429	-6.400	-2.697	-0.782	24.378	1001.192	150	0
148 16:43:01	217	2007 981919305.625 10.225	0.838	0.838	-56.829	0.000	-2.331	-6.400	-2.697	-0.796	24.367	1001.521	149	1
149 17:12:56	217	2007 981919305.743 11.583	0.955	0.955	-58.450	0.000	-2.365	-6.400	-2.697	-0.794	24.384	1001.407	147	3
150 17:42:57	217	2007 981919304.234 11.301	0.935	0.935	-59.963	0.000	-2.469	-6.400	-2.697	-0.793	24.404	1001.060	146	4
151 18:12:58	217	2007 981919303.808 11.434	0.937	0.937	-61.564	0.000	-2.523	-6.400	-2.697	-0.780	24.412	1000.879	149	1
152 18:43:00	217	2007 981919304.875 11.225	0.920	0.920	-63.424	0.000	-2.471	-6.400	-2.697	-0.799	24.454	1001.055	149	1
153 19:13:01	217	2007 981919305.196 14.726	1.202	1.202	-65.666	0.000	-2.649	-6.400	-2.697	-0.793	24.463	1000.460	150	0
154 19:43:01	217	2007 981919304.313 12.603	1.029	1.029	-68.366	0.000	-2.721	-6.400	-2.697	-0.795	24.452	1000.219	150	0
155 20:13:03	217	2007 981919305.637 13.731	1.125	1.125	-71.539	0.000	-2.844	-6.400	-2.697	-0.798	24.444	999.811	149	1
156 20:43:01	217	2007 981919305.299 13.741	1.122	1.122	-75.121	0.000	-2.899	-6.400	-2.697	-0.799	24.429	999.627	150	0
157 21:13:01	217	2007 981919304.057 12.413	1.013	1.013	-79.009	0.000	-2.928	-6.400	-2.697	-0.790	24.431	999.530	150	0
158 21:43:01	217	2007 981919304.999 12.707	1.038	1.038	-83.028	0.000	-3.036	-6.400	-2.697	-0.786	24.434	999.171	150	0
159 22:13:01	217	2007 981919306.333 13.817	1.128	1.128	-86.958	0.000	-2.838	-6.400	-2.697	-0.801	24.459	999.829	150	0
160 22:43:01	217	2007 981919305.623 12.733	1.043	1.043	-90.544	0.000	-2.845	-6.400	-2.697	-0.793	24.492	999.807	149	1
161 23:13:01	217	2007 981919306.768 14.754	1.205	1.205	-93.509	0.000	-2.806	-6.400	-2.697	-0.796	24.468	999.937	150	0
162 23:43:01	217	2007 981919306.155 15.430	1.264	1.264	-95.577	0.000	-2.716	-6.400	-2.697	-0.791	24.460	1000.238	149	1
163 00:12:57	218	2007 981919306.821 14.466	1.189	1.189	-96.479	0.000	-2.600	-6.400	-2.697	-0.790	24.445	1000.622	148	2
164 00:43:01	218	2007 981919306.669 13.290	1.085	1.085	-95.983	0.000	-2.483	-6.400	-2.697	-0.805	24.410	1001.013	150	0
165 01:12:58	218	2007 981919307.728 13.011	1.066	1.066	-93.903	0.000	-2.413	-6.400	-2.697	-0.799	24.390	1001.245	149	1
166 01:43:01	218	2007 981919306.639 14.070	1.149	1.149	-90.101	0.000	-2.383	-6.400	-2.697	-0.784	24.397	1001.345	150	0
167 02:13:01	218	2007 981919306.737 13.086	1.068	1.068	-84.531	0.000	-2.329	-6.400	-2.697	-0.799	24.414	1001.527	150	0
168 02:43:01	218	2007 981919306.006 15.419	1.259	1.259	-77.214	0.000	-2.217	-6.400	-2.697	-0.798	24.430	1001.901	150	0
169 03:13:05	218	2007 981919306.773 17.522	1.440	1.440	-68.232	0.000	-2.142	-6.400	-2.697	-0.791	24.444	1002.151	148	2
170 03:43:01	218	2007 981919308.541 20.267	1.660	1.660	-57.838	0.000	-2.099	-6.400	-2.697	-0.786	24.469	1002.293	149	1
171 04:13:01	218	2007 981919306.778 16.261	1.328	1.328	-46.236	0.000	-2.053	-6.400	-2.697	-0.791	24.476	1002.448	150	0
172 04:43:01	218	2007 981919306.594 17.835	1.456	1.456	-33.767	0.000	-1.986	-6.400	-2.697	-0.780	24.467	1002.670	150	0
173 05:13:01	218	2007 981919306.970 15.260	1.250	1.250	-20.813	0.000	-1.973	-6.400	-2.697	-0.787	24.448	1002.715	149	1
174 05:42:58	218	2007 981919308.033 14.688	1.211	1.211	-7.817	0.000	-1.888	-6.400	-2.697	-0.794	24.428	1002.997	147	3
175 06:13:01	218	2007 981919307.826 16.469	1.345	1.345	4.853	0.000	-1.767	-6.400	-2.697	-0.799	24.439	1003.401	150	0
176 06:43:01	218	2007 981919308.680 15.803	1.290	1.290	16.711	0.000	-1.598	-6.400	-2.697	-0.790	24.437	1003.962	150	0
177 07:13:01	218	2007 981919307.113 16.485	1.351	1.351	27.378	0.000	-1.474	-6.400	-2.697	-0.795	24.434	1004.376	149	1
178 07:43:01	218	2007 981919306.438 18.643	1.538	1.538	36.491	0.000	-1.387	-6.400	-2.697	-0.803	24.457	1004.666	147	3
179 08:13:01	218	2007 981919307.043 15.640	1.281	1.281	43.760	0.000	-1.392	-6.400	-2.697	-0.796	24.464	1004.651	149	1
180 08:42:58	218	2007 981919306.968 17.043	1.401	1.401	48.955	0.000	-1.331	-6.400	-2.697	-0.794	24.476	1004.852	148	2
181 09:13:01	218	2007 981919306.605 16.346	1.339	1.339	51.968	0.000	-1.249	-6.400	-2.697	-0.790	24.454	1005.128	149	1
182 09:43:00	218	2007 981919308.304 18.750	1.546	1.546	52.736	0.000	-1.219	-6.400	-2.697	-0.781	24.426	1005.227	147	3
183 10:13:00	218	2007 981919307.241 16.921	1.386	1.386	51.313	0.000	-1.230	-6.400	-2.697	-0.792	24.392	1005.191	149	1

